RESEARCH, DEVELOPMENT and TECHNOLOGY TRANSFER
QUARTERLY PROGRESS REPORT (QPR)

Wisconsin Department of Transportation (WisDOT)
DT1241 5/2014

INSTRUCTIONS:
Research principal investigators and/or project managers should complete a quarterly progress report (QPR) for each calendar quarter during which the projects are active.

WisDOT Research Program Category	**Report Period** *(enter year and check which quarter)*
☐ Policy Research ☒ Wisconsin Highway Research Program ☐ Other: _____	Year: 2014 ☐ Quarter 1 (Jan 1 – Mar 31) ☐ Quarter 3 (Jul 1 – Sep 30) ☒ Quarter 2 (Apr 1 – Jun 30) ☐ Quarter 4 (Oct 1 – Dec 31)

Project Title	WisDOT Project ID
Laboratory Study of Optimized Concrete Pavement Mixtures	0092-13-04

Principal Investigator Name	Project Oversight Committee Chair Name	Project Start Date (m/d/yyyy)
Konstantin Sobolev	Andrea Breen	8/1/2012
(Area Code) Telephone Number	**(Area Code) Telephone Number**	**Original End Date (m/d/yyyy)**
414-229-3198	414-750-1229	1/31/2015
Email Address	**Email Address**	**Current End Date** (m/d/yyyy)
sobolev@uwm.edu	andrea.breen@lafarge.com	

Project Schedule Status *(check one)*
☒ On Schedule ☐ On Revised Schedule ☐ Ahead of Schedule ☐ Behind Schedule

Project Budget Status

Total Project Budget	Expenditures Current Quarter	Total Expenditures	% Funds Expended	% Work Completed
$199,185.00	$24,211.40	$151,779.61	76%	85%

Project Description
The Wisconsin Department of Transportation (WisDOT) continues to investigate the feasibility of optimization of paving mixtures as a means to improve the engineering properties, lower the required cementitious materials content, reduce cost, and minimize the environmental impacts. Previous research conducted by WisDOT concluded that concrete produced with reduced cementitious materials content had an adequate durability; however, these mixes frequently demonstrated poor workability. As a result, a multi-faceted approach to optimizing mixture proportioning for low-slump mixtures used in concrete pavements is needed for WisDOT to realize the benefits related to the use of lower cementitious materials contents. This approach includes the use of supplementary cementitious materials (SCMs), optimized aggregate gradations, and the use of superplasticizers (high-range water reducing, HRWR admixtures). Current WisDOT practice minimizes the use of portland cement through replacement with SCMs, but does not address the use optimized gradation or superplasticizers. Therefore, additional research is needed to support the development of specifications inclusive of the aforementioned factors to improve the performance and sustainability of concrete paving mixtures used in Wisconsin. This research project evaluates the feasibility of expanding current specifications to incorporate optimized superplasticized concrete in sustainable concrete paving applications.

The goal of this study is to produce guidelines for optimized concrete mix design by evaluating the performance of a range of concrete mixtures. The proposed performance evaluation of optimized concrete will include workability (slump and VB-test), air content, unit weight, compressive and flexural strength, freeze-thaw resistance, and rapid chloride permeability in accordance with relevant AASHTO/ASTM standards. The results of the research will be used to recommend the aggregate gradations and dosage of superplasticizers/HRWR admixtures that will accommodate the use of reduced cementitious materials for the low-slump concrete paving mixtures.

To provide the comprehensive optimization of superplasticized concrete, the proposed project will focus on the following objectives:

1. Develop a detailed, final testing matrix for comprehensive testing of aggregate gradations, SCMs and HRWR admixtures in concrete.
2. Evaluate and compare the composition, microstructural features, and physical properties of different types of cementitious materials essential for their compatibility with HRWR admixtures affecting their performance in concrete.
3. Evaluate the effect of HRWR admixtures on the fresh properties and mechanical performance of concrete.
4. Evaluate the effect of aggregate gradations on the fresh properties and mechanical performance of concrete.

5. Evaluate the effect of SCMs and HRWR admixtures on the stability of air void system, fresh properties, mechanical performance, and durability of concrete.
6. Develop and recommend for practical application an express-method capable of evaluating the performance of SCMs and HRWR admixtures in concrete.
7. Provide Life Cycle Analysis of sustainable optimized concrete paving applications based on the experimental results; submit a final report and recommendations for future work and revision of current specifications.

Progress This Quarter *(includes meetings, work plan status, contract status, significant progress, etc.)*

The 21 “big” batches were produced as per as experimental matrix and were shipped to UW Madison for durability testing. Compressive strength, flexural strength, and length change measurements were performed as per as experimental plan. Durability tests of concrete based on Northern aggregates including rapid chloride permeability and freeze-thaw testing for three types of cement and SCMs were started.

Additional mortar tests required for modeling and optimization of chemical admixtures was started. The statistical analysis of experimental data and development of the relationships between the experimental factors was started.

Anticipated Work Next Quarter

Work that is expected to be completed in the next quarter includes the durability tests at UW Madison including the rapid chloride permeability and freeze-thaw testing. The long-term compressive strength, flexural strength, and length change measurements as per as experimental plan will continue.

Analytical work on synchronizing the optimal dosage of chemical admixtures from mortars to concrete mixtures, and correlating early strength of mortar and concrete mixtures will continue. This will explore the empirical relationships between the results of express-tests and concrete properties and will evaluate the principal parameters affecting the performance. The research team will continue the statistical analysis of experimental data; develop the relationships between the experimental factors and compare these with AASHTO/WisDOT/ACI requirements.

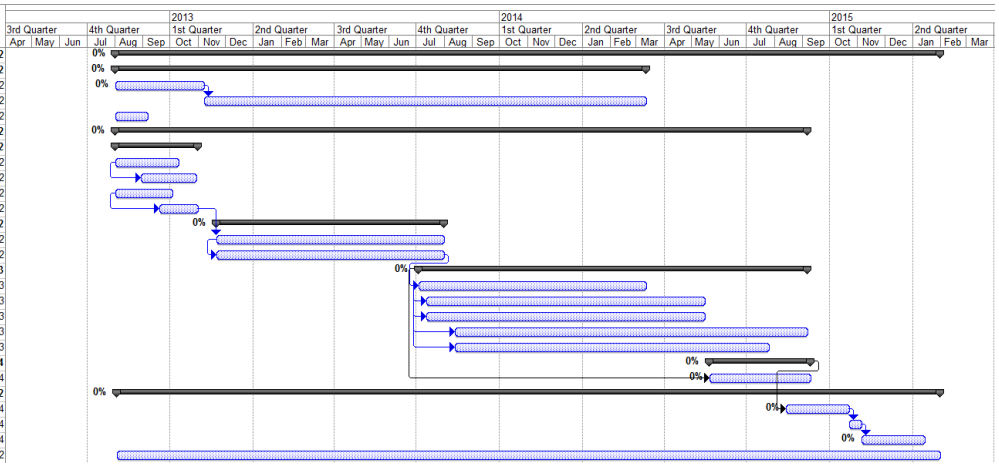
The draft final report will be prepared and submitted to TOC as required by the workplan.

Circumstances Affecting Project or Budget

None

Attach / Insert Gantt Chart and Other Project Documentation

ID	Task Name	Duration	Start
1	**Entire Project**	**653 days?**	**Wed 8/1/12**
2	**Task 1 - Literature Review**	**420 days**	**Wed 8/1/12**
3	Review literature and gather information	70 days	Wed 8/1/12
4	Update literature review as needed	350 days	Wed 11/7/12
5	Task 2 - Finalize the Research Matrix	26 days	Wed 8/1/12
6	**Task 3 - Evaluate Concrete Specimens**	**548 days?**	**Wed 8/1/12**
7	**Collect & Characterize Materials**	**65 days?**	**Wed 8/1/12**
8	Collect Cementitous Materials	50 days	Wed 8/1/12
9	**Characterize Cementitious Materials**	44 days	Wed 8/29/12
10	Identify and collect aggregates	45 days?	Wed 8/1/12
11	Characterize aggregates	30 days	Wed 9/19/12
12	**Optimization of Aggregates & HRWR**	**180 days**	**Wed 11/21/12**
13	Prepare optimized aggregates	180 days	Wed 11/21/12
14	HRWR - cement compatibility & dosages	180 days	Wed 11/21/12
15	**Optimized Mixtures**	**308 days**	**Wed 7/3/13**
16	Plastic properties	180 days	Wed 7/3/13
17	Compressive Strength	220 days	Fri 7/12/13
18	Flexure Strength	220 days	Fri 7/12/13
19	Freeze-thaw Resistance	280 days	Mon 8/12/13
20	Rapid Chloride Permeability	250 days	Mon 8/12/13
21	**Task 4 - Data Analysis**	**80 days**	**Wed 5/21/14**
22	Comprehensive data analysis	80 days	Wed 5/21/14
23	**Task 5 - Reporting**	**651 days**	**Fri 8/3/12**
24	Draft final report	50 days	Wed 8/13/14
25	Report presentation to RPTOC	10 days	Wed 10/22/14
26	Review, Revise and Submit Final Report	50 days	Wed 11/5/14
27	**Quarterly Progress Reports**	651 days	Fri 8/3/12



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For WisDOT Use Only	
Staff Receiving QPR J. Walejko	Date Received (m/d/yyyy) 7/9/2014
Staff Approving QPR	Date Approved (m/d/yyyy)